Position Statement
NIH/NSF Visualization Research Challenges Workshop

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High-Resolution Visualization:
A primary form factor of computing user interfaces of the future will likely be very high resolution displays. New display technologies are simultaneously increasing pixel density and screen size. IBM's Big Bertha LCD display offers 5x pixel density, and rumors indicate that 15-20x are coming soon. Wall-sized displays of tiled LCD and rear-projection arrays are becoming popular in research labs, offering 10-100 megapixels. The next major milestone is a gigapixel display. Some day, all architectural surfaces will be coated in pixels. This raw display capability offers new, mostly untapped, future potential for visualization. How can visualization take advantage of near boundless display?

There are obvious computational hardware and software questions about rendering so many pixels. Here I emphasize the HCI aspects of high-resolution interactive information visualization. The essential problem is that much of the existing research in visualization has been concerned with perceptual and interactive issues of packing information onto small displays, e.g. using aggregation and interactive navigation strategies. We are fairly clueless about what to do with near infinite pixels.

- What should be the display form factor? Shape (wall, cylinder, semi-sphere, etc.)? How many pixels? What pixel density?
- How to deal with display technology artifacts? LCDs or rear-projection? How to handle seams between tiled LCDs?
- What are the limits of visual data perception? How much information can be displayed? What exactly is the benefit of high-resolution for visualization?
- How to organize and layout information on such large displays? In contrast to current overview strategies, can significant quantities of details be embedded directly in the display? Can multiple views (dozens?) be spread across the display, or should more integrated multi-scale information spaces be designed?
- How to interact with large visualizations? (mousing across a billion pixels will certainly be problematic!) What interaction devices? How to design interaction techniques such as selecting data and viewing details? How should navigation strategies adapt? Should people physically navigate (look, walk, etc.), or use virtual navigation (pan, zoom, etc.)?
- How do the answers to all these questions change when considering single- vs. multi-user environments? How do groups of users simultaneously interact with high-resolution visualizations?

These are hard questions that will require a lot of work and investment. One useful approach being taken by Virginia Tech, Illinois' EVL, and others, is the development of highly reconfigurable display facilities that will enable experimentation on many alternative designs. If answers to these questions can be found, visualization will be well-prepared for the future. New visualization methods that effectively exploit the raw capability of high-resolution display can open up many new possibilities for massive data visualization.